

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE
 NUMBER:05-1-FC3042 -X

SUBSYSTEM NAME: GUIDANCE, NAVIGATION, & CONTROL
 REVISION: 0 02/09/82

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
LRU :ROTATION HAND CONTROL	MC621-0043-3047

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 ROTATION HAND CONTROL (RHC), CMDR, PILOT AND AFT STATION.

REFERENCE DESIGNATORS: 30V73A5
 30V73A6
 30V73A7

QUANTITY OF LIKE ITEMS: 3
 TWO FWD (CMDRS, PILOT)
 ONE AFT STATION

FUNCTION:
 PROVIDES MANUAL COMMANDS FOR ROTATIONAL CONTROL OF THE SHUTTLE AND ORBITER DURING ALL PHASES OF THE MISSION. PROVIDES A COMMUNICATION PUSH TO TALK, PITCH AND ROLL TRIM SWITCH AND PROVIDES THE BACKUP FLIGHT SYSTEM (BFS) ENGAGE FUNCTION SWITCH.

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 05-1-FG3042-01

REVISION#: 1 01/03/96

SUBSYSTEM NAME: GUIDANCE, NAVIGATION, & CONTROL

LRU: ROTATION HAND CONTROL

ITEM NAME: ROTATION HAND CONTROL

CRITICALITY OF THIS

FAILURE MODE: 1/1

FAILURE MODE:
ERRONEOUS OUTPUT (TWO OR MORE CHANNELS)

MISSION PHASE: DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

CAUSE:
PHYSICAL JAMMING DUE TO VIBRATION, MECHANICAL SHOCK, MISHANDLING/ABUSE,
PIECE-PART STRUCTURAL FAILURE, CONTAMINATION OR LINKAGE FAILURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) N/A
	B) N/A
	C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF ONE OF TWO REDUNDANT FORWARD STATION OR AFT STATION RHC'S.

(B) INTERFACING SUBSYSTEM(S):
SAME AS (A)

(C) MISSION:

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE
NUMBER: 05-1-FC3042-01**

LOSS OF CREW/VEHICLE IF RHC JAMS, OR LINKAGE FAILS, WHILE DEFLECTED DURING FINAL FLARE AND LANDING APPROACH MANEUVERS.

(D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (C)

(E) FUNCTIONAL CRITICALITY EFFECTS:
CRITICALITY 1 BECAUSE OF INADEQUATE TIME FOR CREW TO DETECT FAILURE, REMOVE POWER FROM AFFECTED RHC AND REGAIN CONTROL WITH OTHER RHC STATION.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE ELECTROMECHANICAL DESIGN HAS A CERTIFIED OPERATIONAL LIFE OF 23,500 HOURS. THE QUALIFIED CYCLIC LIFE FOR THE MAJOR AXES (ROLL,PITCH) IS CERTIFIED FOR 75,000 ACTUATIONS AND 50,000 ACTUATIONS FOR THE YAW AXIS. THE COMMUNICATION AND TRIM SWITCH DESIGNS HAVE A DEMONSTRATED AND CERTIFIED CYCLIC LIFE OF 10,000 ACTUATIONS. ANALYSIS OF THE LOAD BEARING MECHANISMS INDICATE A YIELD LIMIT OF AT LEAST 1.4 TIMES THE OPERATIONAL DESIGN LOAD. THE NULL RETENTION SPRINGS ARE TIED THROUGH COIL CENTER, TO PREVENT A JAMMING CONDITION SHOULD ONE BREAK.

THE FLIGHT CERTIFIED DESIGN INCLUDES A NEWLY CERTIFIED CONFIGURATION OF THE FLEX CABLE FOR IMPROVED RELIABILITY. THE QUALIFICATION REQUIREMENTS TO CERTIFY THIS DESIGN INCLUDED TWO SERIES OF CYCLIC TESTS, EACH EQUIVALENT TO 1.5 TIMES THE 100 MISSION LIFE REQUIREMENTS FOR CONSERVATIVE MEASURES. UNIT IS COMPLETELY ENCLOSED TO PREVENT DEBRIS FROM ENTERING AND JAMMING MECHANISM.

ALL ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PIECE PARTS WHICH MAKE UP THE RHC ARE CONTROLLED TO THE ORBITER PROJECT PARTS LIST (OPPL) REQUIREMENTS OF MF0004-400. PASSIVE EEE PARTS AND ELECTRICAL CONNECTORS ARE MILITARY QUALIFIED AND 100% SCREENED TO OPPL REQUIREMENTS. MICRO-CIRCUITS ARE QUALIFIED TO MIL-M-38510 AND SCREENED TO MIL-S-883, LEVEL B. SEMICONDUCTOR DEVICES ARE JANTXV LEVEL. CIRCUIT DESIGN LIMITS WORST CASE JUNCTION TEMPERATURES TO 95 DEG C, AND ELECTRICAL STRESSES TO 50% OF RATED CAPABILITY FOR ALL PARTS.

(B) TEST:
ACCEPTANCE TESTING, WHICH INCLUDES ACCEPTANCE THERMAL TESTING (ATT) AND ACCEPTANCE VIBRATION TESTING (AVT), IS PERFORMED ON EACH UNIT. QUALIFICATION TESTING, INCLUDING VIBRATION, SHOCK, TEMPERATURE WAS COMPLETED TO CERTIFY DESIGN. INTEGRATED/SUBSYSTEM VERIFICATION IS PERFORMED DURING TURNAROUND. FUNCTIONAL TEST OF ROTATIONAL HAND CONTROLLER MONITORED TO VERIFY OPERATION WITHIN SPECIFICATION.

(C) INSPECTION:
RECEIVING INSPECTION
INCOMING MATERIAL IS VERIFIED BY RECEIVING INSPECTION.

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE
NUMBER: 05-1-FC3042-01

CONTAMINATION CONTROL
HARDWARE AND FACILITY CONTAMINATION CONTROL MONITORED BY INSPECTION.
FINAL ASSEMBLY AND REWORK PERFORMED IN A CLEAN ROOM.

ASSEMBLY/INSTALLATION
QUALITY PLANNING ENSURES ALL DRAWING AND PROCUREMENT REQUIREMENTS ARE
PUT INTO IN-PROCESS WORK TICKETS. TORQUING (ACCEPT/REJECT) VERIFIED BY
INSPECTION. MECHANICAL RIGGING AND TORQUING ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC ANALYSIS, ULTRASONIC TESTING, DYE PENETRANT AND MAGNETIC
PARTICLE ANALYSIS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
POTTING, BONDING, FUSION WELDING, SOLDERING AND MATERIAL CLEANING VERIFIED
BY INSPECTION.

TESTING
ENVIRONMENTAL ACCEPTANCE TESTING IS OBSERVED AND VERIFIED BY QUALITY
CONTROL.

HANDLING/PACKAGING
THE PACKING AND PACKAGING REQUIREMENTS ARE MET BY USE OF SPECIAL
QUALIFIED CONTAINERS FOR IN-PLANT TRANSPORTATION AND SHIPPING.

(D) FAILURE HISTORY:
NO PHYSICAL JAMMING FAILURES INCLUDING LINKAGE FAILURES HAVE OCCURRED
DURING DEVELOPMENT, QUALIFICATION, ACCEPTANCE, FIELD TESTING, AND FLIGHT
OPERATIONS.

(E) OPERATIONAL USE:
NONE.

- APPROVALS -

EDITORIALLY APPROVED	: RI	: <u><i>Jumb</i></u> <u><i>1/17/96</i></u>
EDITORIALLY APPROVED	: JSC	: <u><i>Tom Service</i></u> <u><i>1-25-96</i></u>
TECHNICAL APPROVAL	: APPROVAL FORM	: 95-CIL-001-RI